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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G02B 5/02, G03B 21/60

A1

(11) International Publication Number: WO 96/20419

(43) International Publication Date: 4 July 1996 (04.07.96)

(21) International Application Number: PCT/GB95/03044

(22) International Filing Date: 28 December 1995 (28.12.95)

(30) Priority Data:

9426292.0	28 December 1994 (28.12.94)	GB
9500025.3	4 January 1995 (04.01.95)	GB
9521103.3	16 October 1995 (16.10.95)	GB

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(81) Designated States: CA, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published

With international search report.

(54) Title: LIGHT DIFFUSING MATERIAL

(57) Abstract

Light diffusing sheet material, for example for projection screens, is produced by deforming a sheet of light diffusing material along at least one axis in the plane of the material. By stretching the material along a single axis, for example, a light diffusing material having asymmetric light-diffusing characteristics can be produced. By stretching the sheet material bi-axially, the light-spreading effect, or angle of view, of the sheet material can be changed. Preferred starting light diffusing materials include materials incorporating arrays of graded refractive index lenses and materials comprising particles with one refractive index embedded in a matrix of another refractive index.

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DESCRIPTION OF INVENTION

Title: "Light diffusing material"

THIS INVENTION relates to light diffusing sheet material such as may be used, for example, in front or rear projection screens.

A conventional rear projection or front projection screen has a completely symmetrical diffusion characteristic, that is to say, given uniform illumination of an element of the diffusing sheet material by a parallel beam striking the rear surface of such element, the intensity of the light directed, by the screen, from said element, along an axis inclined at an angle α to the normal to the element, measured in a plane perpendicular to the plane of that element will be the same whatever such perpendicular plane is selected. Thus, where a diffusing screen having a completely symmetrical diffusion characteristic is used as a rear projection screen lying in a substantially vertical plane and light is projected normally onto the diffusing screen, the light from the screen will be spread just as much horizontally as vertically. There are, however, instances in which it would be desirable for such a screen to have asymmetrical diffusion characteristics so that, for example, it would spread light from the screen horizontally to a substantial extent but would spread such light much less vertically. Such an arrangement might be used to ensure that each of a plurality of observers seated at different locations in a room and thus, in effect, distributed in a generally horizontal plane, would see the screen as being illuminated adequately whilst at the same time ensuring that light was not lost needlessly by scattering upwardly and downwardly towards the ceiling or floor of the room respectively.

In the following, reference is made to the "angle of view". In this specification, the term "angle of view" refers to the range of viewing angles of observers relative to such a front or rear projection screen over which the apparent brightness of a central area of the screen is within 50% or more of the apparent brightness to an observer viewing the screen at right angles.

European Patent No. 294122 discloses a display system including a projection screen comprising an integral sheet of a transparent photopolymer comprising an array of graded refractive index lenses, each of these lenses being formed by a respective region of the sheet extending between the surfaces of the sheet with the refractive index, in each said region, varying gradually with radial distance from the optical axis of the respective lens.

The photopolymer used may be that supplied by Du Pont under the Registered Trade Mark OMNIDEX and having the type designation HRF150 or HRF600. The monomer in the HRF series photopolymers is N-vinyl-carbazole (NVC) dispersed in a plasticized polyvinyl acetate (PVAC), cellulose acetate butyrate (CAB) or polyvinyl butyrate (PVB) as the polymeric binder. The material may be initiated either by photoinitiators or by a photosensitizing dye/initiator combination.

The OMNIDEX materials are available in sheet form, comprising a layer of the monomer on a polyester film base (MYLAR) the layer being entirely covered with a polyester (MYLAR) film.

Further photopolymerisable materials which may be used are set out in US Patent No. 3658526.

Normally a diffusion screen manufactured by the method disclosed in EP 294122 has a completely symmetrical diffusion characteristic.

Another form of known light diffusing sheet material is that disclosed in U.S. Patent No. 5307205 and which comprises a matrix of a first plastics material, for example, polymethylmethacrylate, in which is embedded a plurality of small, substantially spherical, particles of a second light transmitting plastics material, for example, alkyl acrylate resin or butyl acrylate resin, of a different refractive index, and which is of a rubbery consistency.

Japanese Patent Application No. 5-113606 describes a process for making reflective screens having anisotropic light diffusing properties by extruding through a die a liquid blend of phase incompatible resins thereby forming a film of one resin having light diffusing islands of the other resin embedded therein. Uniaxial drawing processing is said to convert these islands to ellipsoidal form with their major axes oriented in the drawing direction.

It is an object of the invention, in one aspect, to provide a method of changing the optical characteristics of a light diffusing material.

According to this aspect of the invention there is provided a method of changing the optical characteristics of a light diffusing sheet material comprising providing a sheet of such material which is deformable at least at some temperature and deforming the material along at least one axis in the plane of the sheet material.

It is an object of the invention in another of its aspects to provide an improved method of making a light diffusing material having asymmetric light diffusing properties.

According to this aspect of the invention there is provided a method of producing a light diffusing sheet material having asymmetric light diffusing properties, comprising providing a light diffusing sheet material which is deformable at least at some temperature and stretching the material preferentially along an axis in the plane of the sheet material.

The method of the invention may be applied to light diffusing sheet materials such as the graded refractive index lens screen material described in European Patent No. 294122, or to a light diffusing sheet material, such as disclosed in WO91/18304, which comprises graded refractive index screen material in which at least one surface of the sheet material has a contouring or relief corresponding to the refractive index gradations, for example comprising a respective convex dome or concave dimple for each graded refractive index lens, aligned with and adding its optical effect to the respective graded refractive index lens. The method is also applicable to a variant of the last-mentioned material in which each surface relief lens is substantially larger in diameter than the graded refractive index lenses and spans a plurality of these.

The method of the invention may also be applied to light diffusing sheet materials of the kind disclosed in US Patent No. 5307205. Thus, a sample of such sheet material, having initially symmetric diffusion characteristics, can be converted into a material having asymmetric diffusion characteristics by heating the

material to a temperature at which it is slightly softened, stretching the material along an axis within the plane of the material, and allowing the material to cool in its stretched condition. It is believed that, in this instance, the asymmetry is the result of a distortion of the individual (initially spherical) particles, and/or from the microspheres adjacent the surface of the material distorting that surface during stretching, providing an asymmetric surface relief effect, for example forming a respective asymmetric dome above each such particle adjacent said surface.

Diffusing sheet materials are also known in which some or all of the diffusing effect is attributable to surface contouring or irregularity, which may, for example, take the form of an array of minute part-spherical dome regions on the surface of the material or may comprise a less regular structure. Again, asymmetric diffusion characteristics may be induced in such sheet material by heating to a softening temperature and stretching preferentially along an axis in the plane of the material. Where the material has a surface configuration comprising an array of part-spherical domed regions, these are distorted, by such stretching, into oval or elliptical regions.

In the various embodiments of this invention utilising uni-axial stretching, it is believed that the effect of the stretching is to elongate each of the microlenses, along the direction of stretching, and thus perpendicular to its optical axis so that each lens is rendered astigmatic.

Brief Description of Figures

Figure 1 is a typical graph of modulus of elasticity against temperature for a typical cross-linked plastics material and a corresponding non-cross-linked plastics material.

Figure 2 is a graph of stress versus strain for the same cross-linked and a corresponding non-cross-linked plastics material at room temperature.

Figure 3 is a graph of stress versus strain for the same cross-linked and non-cross-linked materials at a temperature close to melting point of the non-cross-linked material.

Figure 4 is a typical graph of stress versus strain for two cross-linked counterparts to the same un-cross-linked material with different cross-linked densities, at a temperature above the melting point of the corresponding un-cross-linked material.

Examples of the use of methods embodying the invention to produce light diffusing material having asymmetric diffusing characteristics are described below.

EXAMPLE 1

A light-diffusing photopolymerised sheet material was produced as described in European Patent Specification No. 294122, and thus incorporated an array of graded refractive index microlenses. This light diffusing material had symmetrical light diffusion characteristics and an angle of view of 46°. The starting photopolymerisable material for this light diffusing material was the DuPont MRF600 material referred to above,

having a thickness of 93 microns. A sample strip of this light diffusing material 45 mm in width (and stripped from its Mylar backing) was heated to 130°C, at which temperature the material became slightly softened, then stretched longitudinally to a ratio of 2:1 (i.e. was stretched to twice its original length) and then cooled in its stretched condition so that the stretch remained permanent. After stretching the width of the strip had reduced to 25 mm. The diffusion characteristics of the stretched strip were found to be asymmetrical, having an angle of view of 37° in a plane parallel with the longitudinal direction of the strip and an angle of view of 47° in a plane perpendicular to the direction of the strip.

An example of the method applied to a light diffusing material of the type disclosed in US Patent No. 5307205 is set out below.

EXAMPLE 2

Light diffusing film DFA12 provided by the 3M Company, having a viewing angle of 20° (50% of peak brightness) was stretched at 80°C, causing a reduction in thickness of about 20% (from 0.0065 in to 0.0055 in), cooled to room temperature and the view angle re-measured. After orientation, the angles of view were 26° in the direction of orientation and 22° in the perpendicular direction, thus demonstrating that asymmetry had been created and the angle of view changed.

EXAMPLE 3

The table below sets out the results obtained by applying the method of Example 2 to further light diffusing

sheet plastics materials, supplied by Marshall & Williams Corporation under the designations MW11, MW13, MW2, MW3 and MW6, the stretching temperatures, stretch ratios and final sheet thickness being as indicated in the columns heated "S Temp.", "S Ratio" and "FT" respectively. The initial thickness of the sheet material in each case was 20 thousandths of an inch (500 μM). The headings "A of V (vert)" and "A of V (hor)" refer to the angles of view (as hereinbefore defined) respectively in a longitudinal plane parallel with the stretch direction and in a plane perpendicular to the stretch direction. The heading "Gain" refers to the ratio of the apparent brightness of the screen, illuminated normally, when viewed normally, to the average apparent brightness (averaged over a full solid angle of 180°). Temperatures in the table are in °F and thicknesses in thousandths of an inch. Angles of view are in degrees.

TABLE

Material	S.Temp	S.Ratio	AofV (hor)	AofV (vert)	Gain	FT
MW11	215	2.00	35	17.5	11.09	13.5
MW13	225	2.00	37	19	11.70	14.5
MW2	215	1.25	34.5	25	8.39	17.5
MW3	215	1.58	31	19.5	12.05	14
MW6	220	1.71	29.5	19	12.98	13.5

It has also been found that, with a diffusing material in accordance with U.S. Patent No. 5307205 the stretching appears to produce a net increase in the extent

to which the diffuser "spreads" the light, i.e. the stretching results in an increase in the "angle of view". Accordingly, it is possible to produce an increase in this "spreading" effect, without departing from the symmetry of light diffusion, by stretching the material at elevated temperature simultaneously in two mutually perpendicular directions in its plane, the material again being maintained in its stretched condition whilst being allowed to cool so that the resulting stretch in the material remains permanent. It is believed that this effect also may be reproducible in other forms of diffusing material referred to.

Whilst in the examples set out above, the light diffusing material were oriented by stretching, after heating to soften the material, the invention is not limited to heating, softening or stretching. There are a number of ways of orienting sheet polymer materials which will be known to those skilled in the art, who should have no difficulty in selecting appropriate techniques applicable to any particular diffusing material. Orientation of polymer materials typically, but not always, takes place at a temperature above the normal use temperature and below the temperature at which the material becomes fluid. The orientation process may take place as part of the basic fabrication process, for example, the orientation of polymer fibre following extrusion or subsequently, for example vacuum forming of articles from a previously fabricated sheet. Methods of orienting plastics may be uniaxial (for example with fibres) or biaxial (for example with sheet or film) and the range of techniques available is well known to those skilled in the art.

It will be understood that whereas, in the above, reference is made to "stretching" the material, such "stretching" need not be produced by pulling the material, but may, for example, be produced by extrusion or by passing the material through a nip between rollers.

In the above examples, heating is used in conjunction with orientation to achieve specific (desired) changes in angle of view. However, there will be instances in which orientation will take place at room temperature and it is not inconceivable that temperatures below room temperature might be used in some instances.

Thus, for example, a light diffusing plastics material may be stretched at room temperature sufficiently to undergo non-elastic deformation and orientation, by techniques know *per se* for orienting plastics film.

In some embodiments in which a matrix of one refractive has particles of different refractive index embedded therein, said particles embedded in the matrix may be rigid at room temperature but may soften, so as to be deformable or stretchable at the temperature to which the matrix material is heated for stretching or otherwise orienting.

In the context of this invention, the most appropriate method of deformation of the light diffusing sheet material will be chosen based on the starting material, for example, whether it is crosslinked and thus non-melting as is often the case with photopolymer based material, or is thermoplastic as described in USP 5307205, and the change in character required, that is whether it is desired to create asymmetric optical characteristics, whether it is desired to change the angle of view, or a

combination of these two. For example, orientation in a single direction will create asymmetry. Orientation in two directions may or may not create asymmetry dependant on the degree of orientation but will change view angle. In heterogeneous materials such as those described in USP 5307205 where optical properties are achieved by mixing two or more materials, the effects of orientation will, to an extent, be determined by the separate physical characteristics of these materials. This is best understood by considering relatively hard particles contained in an originally smooth surfaced sheet. As stretching takes place, these particles will increasingly modify the surface of the sheet. It will be understood that if the particles are originally spherical, convex "bumps" will be created on the surface of the sheet, forming surface relief lenses. It will be understood that by the correct choice of material and process temperature, the relative physical properties of the component materials in mixed systems can be chosen to enable specific surface relief and/or asymmetry characteristics to be achieved.

A further embodiment of the invention utilises cross-linked thermoplastics. Cross-linking of thermoplastics materials is now a relatively well known technology, pioneered in the 50s by Charlesby and commercialised in the late 50s and 60s by Raychem and W.R. Grace. When thermoplastics are cross-linked, they no longer melt when heated but exhibit elastic or elastomeric characteristics above the melting point of the corresponding un-cross-linked plastics. If heated to above the melting point of the corresponding un-cross-linked plastics, stretched, then cooled, cross-linked thermoplastics will retain their stretched configuration until reheated, when they will return, generally completely, to their original dimensions.

Figures 1 to 3 illustrate the modification of the physical properties of a thermoplastics material (polyethylene in the example illustrated) by cross-linking. In these Figures, the graphs relating to the un-cross-linked material are in solid lines and the graphs relating to the cross-linked material are in dotted lines.

Figure 1 shows by way of example of a graph of modulus of elasticity against temperature for both crosslinked and non-crosslinked versions of essentially the same material; in this instance, certain types of polyethylene. Different thermoplastics may have significantly different overall properties but the effects of crosslinking are generally similar.

Figure 2 is a graph of stress versus strain for both materials of Figure 1 at room temperature, Figure 3 is a corresponding graph showing respective curves for the cross-linked and non-cross-linked material at a temperature close to melting point of the non-cross-linked material, whilst Figure 4 is a graph corresponding to Figure 3 for two cross-linked counterparts to the un-cross-linked material of the other graphs, with different cross-link densities, at a temperature above the melting point of the corresponding un-cross-linked material. Cross-linking thus provides considerable flexibility in the orientation of polymer materials, and in the case of materials otherwise as described above, makes it easier to obtain a predetermined degree of asymmetry.

Non-crosslinked materials, when orientated at elevated temperatures by any of the techniques disclosed above, must be cooled during stretching simply to ensure that the thinning areas (which cool more quickly) build up mechanical strength, thus ensuring that the thicker

(hotter) areas become appropriately stretched. This principle is utilised in the "blown film" process most commonly used for making plastic bags. A given thermoplastic material will have an optimum (maximum) degree of orientation. Levels below the optimum are very difficult to obtain by heating and stretching, specifically, if a "uniform" product is required. In some instances, the only effective approach is to use a "nip roll" process in which material is compressed to induce thickness reduction and thus orientation.

Similar constraints do not exist with cross-linked thermoplastics and a simple stretching process at high temperature can achieve a range of orientation levels within the elongation capabilities of the material.

Cross-linking may be achieved by several techniques, the more common are high energy radiation, e.g. by electron beams or X rays, UV radiation or by chemical treatments, for example using peroxides.

The degree of cross-linking can be readily controlled and, in embodiments comprising particles of one refractive index embedded in a matrix of a different refractive index, this can be true of both the host polymer and the material of the embedded particles.

Since both temperature and cross-link density affect the elastic modulus of the polymer structure on a microscopic level, it becomes clear that cross-linked thermoplastics materials can provide great flexibility in the creation of asymmetric diffusers of the type outlined above.

Whilst, as described above, cross-linking of the thermoplastics matrix may be effected before stretching of the material, cross-linking may alternatively be effected whilst the material is stretched, (either partially stretched or stretched to the extent at which it will be finally) or some cross-linking may be effected with the material unstretched and further cross-linking carried out with the material stretched.

Cross-linked thermoplastics have improved thermal characteristics. However, if cross-linking takes place before orientation then a loss of orientation may occur at elevated temperature, for example as the melting temperature of the corresponding un-cross-linked plastics is approached. Cross-linking after orientation will tend to "lock in" orientation and other effects.

Controlled cross-linking of the substrate will eliminate the need for melting or near-melting of the material prior to stretching and provide much greater flexibility in the choice of stretching temperature. Controlled cross-linking also eliminates the need for cooling during stretching.

Whilst the description above in relation to cross-linking has been directed to a material comprising a matrix of one plastics material incorporating particles of another material of different refractive index, a similar cross-linking technique can be applied to the photopolymer-based graded refractive index screen material referred to above in Example 1. It is true that the photopolymer based graded refractive index material described with reference to Example 1 above may already be cross-linked to some extent as a result of the selective UV exposure utilised to produce the graded refractive index lenses or other graded

refractive index features. However, as a means of optimising the orientation process, further cross-linking may be deliberately induced. Where, as is the case with the preferred photopolymerisable material, the material incorporates cross-linkable components such as PVA any such component of the photopolymer and indeed any unreacted monomer could be further polymerised, for example, using electron beam irradiation, which could change the orientation and asymmetry characteristics of the material but without significantly affecting the fundamental diffusion characteristics such as angle of view.

As regards the embodiments described above where a thermoplastics material has light diffusing characteristics which are due to surface relief characteristics or features, variants of such embodiments are possible where the material is cross-linked before, during or after stretching or other orientation.

Depending on the application, the techniques described may be used to create asymmetry, modify the angle of view or both. Using this technique it is clearly possible to change the optical characteristic in a single sheet of material and indeed vary the properties within that sheet. For example, vacuum forming a flat sheet of the material into a simple (hemisphere) or more complex shape will give a variety of orientations and thus view angle differences within a single piece.

With some diffusing materials, stretching the material actually appears to reduce rather increase the angle of view. This effect, also, is considered to be within the scope of the invention.

It will be understood that any of the diffusing materials referred to above may be used as a rear projection screen (i.e. as a diffusing transmission screen) or may be laminated with a reflective layer to form a reflective or front projection screen. The reflective layer may be applied after stretching, where the reflective layer is non-stretchable, or before stretching if the reflective layer is stretchable without detriment to its reflective properties.

Methods for applying reflective layers on screen materials are well known, and do not form a part of this invention. Generally, reflective screens of the present invention can be produced by depositing or laminating a layer of reflective material on one surface of the screen. For example a reflective screen can be made by laminating the screen material with reflective MYLAR or with a metallised film. Reflective screens also can be made by direct metallisation of the screen material using well established techniques.

It is possible to incorporate further properties in a light diffusing screen in accordance with the invention by means known *per se*. For example, such a screen may incorporate a reflection reducing coating or coatings, or may have additives or treatment to render the screen birefringent or polarising.

As noted above whilst, in many embodiments of the invention, the plastics material is heated in order to soften it for stretching, heating is not invariably essential. Where the material is heated, the optimum temperature to which the material may be heated depends upon the material concerned and also upon the technique used for stretching or orienting the material. In general,

where the material is heated, the temperature to which it is heated will be in the range 70°C to 150°C. For acrylics or acrylic-based materials, the temperature used may typically be in the region 100°C to 120°C.

As also noted above "stretching" or orienting the plastics sheet material, in carrying out the present invention, may be carried out in any of a variety of ways.

Basically there are two types of orientation process; those in which the material is compressed; the second in which the material is stretched mechanically or using air pressure (or lack thereof) in one or more directions.

Typically in a compression process a sheet of material is run through the nip of the two-roll or multi-roll stack. The nip separation is less than the initial thickness of the material. In the process the thickness is reduced and the length increased. The increase in width is small, but it will increase with the increase in temperature. For best results a temperature difference is established between the roll stack and the material as it enters the roll stack. If more than one pair of cooperating rolls is used there will typically be a change in temperature of the material from one pair of rolls to the next (and successive pairs of rolls may be maintained at different temperatures).

Stretching may be uniaxial and biaxial. Stretching may be achieved by processes corresponding to known blow moulding and vacuum forming processes or by a process corresponding to the blown-film method used for making (for example) polyethylene film. These methods all involve cooling during the stretching part of the process.

However, the currently preferred method, particularly where the starting material is either sheet or roll stock, uses an apparatus which has three heating zones; namely a preheating zone where the material is heated before any significant deformation takes place; a subsequent stretching zone, where the material may also be heated; and, optionally, a subsequent annealing zone. Provided that stretching is complete in the stretching zone, annealing may in fact impair performance. In this process material can be stretched longitudinally, laterally or in both directions. Longitudinal stretching is achieved by using differential roll speeds within the machine. Lateral stretching is achieved by gripping the sides of the material at discrete points then moving the grippers apart. The grippers may, for example, run in diverging rails and be drawn by chains along these rails whereby the material is stretched laterally as it is conveyed longitudinally. In this apparatus the stretching is purely lateral. Rail separation and rate of separation can be varied.

CLAIMS

1. A method of changing the optical characteristics of a light diffusing sheet material comprising providing a sheet of such material which is deformable at least at some temperature and deforming the material along at least one axis in the plane of the sheet material.

2. A method of producing a light diffusing sheet material having asymmetric light diffusing properties, comprising providing a light diffusing sheet material which is deformable at least at some temperature and stretching the material preferentially along an axis in the plane of the sheet material.

3. A method according to claim 1 or claim 2 wherein the light diffusing sheet material on which the deforming or, respectively, stretching, step is performed comprises an array of graded refractive index lenses.

4. A method according to claim 1 or claim 2 wherein the light diffusing material on which the deforming or, respectively, stretching, step is performed comprises a plurality of particles of a first refractive index embedded in a matrix of a material of a second refractive index.

5. A method according to claim 1, 2 or 3 wherein the light diffusing material on which the deforming or, respectively, stretching, step is performed is one having a surface relief configuration imparting a light diffusing property to the sheet.

6. A method of modifying the light diffusing properties of a light diffusing sheet material, and in

particular of modifying the polar light diffusion characteristic of such a sheet material, said sheet material being deformable at least at some temperature, the method comprising stretching the material in its plane of extension.

7. A method according to any preceding claims wherein the sheet material is cross-linked before, after, or during such deformation.

8. An optical display or light diffusing screen comprising a polymer film oriented to achieve desired angle of view characteristics or asymmetrical diffusing characteristics.

9. A screen according to claim 8 comprising an oriented polymer film having a reflective backing.

10. A screen according to claim 8 or claim 9 wherein said polymer film is a photopolymer film incorporating an array of graded refractive index lenses which are elongated in one direction perpendicular to their optical axes by virtue of the orientation of the polymer.

11. A screen according to any of claims 8 to 10 wherein said polymer film has a surface formed with an array of domes or dimples forming surface-refractive microlenses, said microlenses being elongated in one direction perpendicular to their optical axes by virtue of the orientation of the polymer.

12. A screen according to any of claims 8 to 11, wherein said polymer comprises a matrix of a first polymer in which is embedded a plurality of particles of a second polymer of a different refractive index from the first

polymer, and wherein said particles are flattened relative to a spherical form, in a direction or directions which is or are substantially the same for all of said particles.

13. A screen according to any of claims 8 to 11 wherein said polymer film comprises a matrix of a first polymer in which is embedded a plurality of particles of a second polymer of a different refractive index from the first polymer and wherein at least one surface of the polymer film has an array of bumps or domes forming microlenses, each said bump or dome overlying a respective said particle.

14. A screen according to any of claims 10 to 13 wherein said polymer film is cross-linked.

15. A method of producing a light diffusing material having asymmetric light diffusing properties, substantially as hereinbefore described.

16. A screen according to claim 8 and substantially as hereinbefore described.

17. An optical system incorporating a screen according to any of claims 8 to 13 or produced by the method of any of claims 1 to 6.

18. Any novel feature or combination of features described herein.

Fig.1.

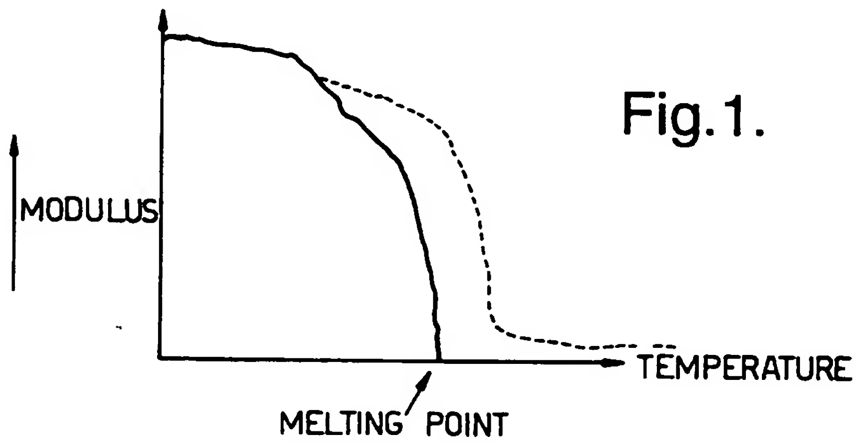


Fig.2.

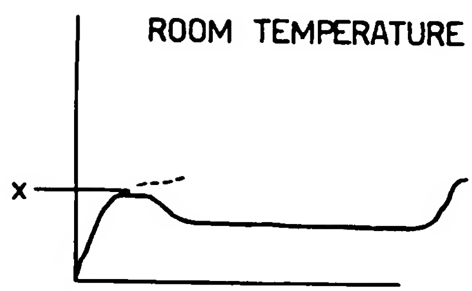


Fig.3.

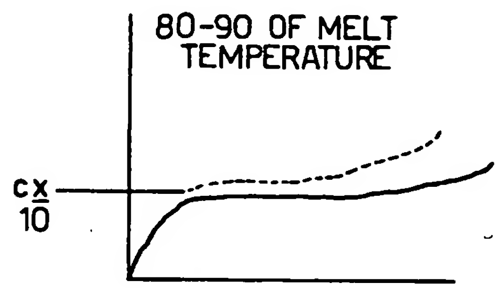
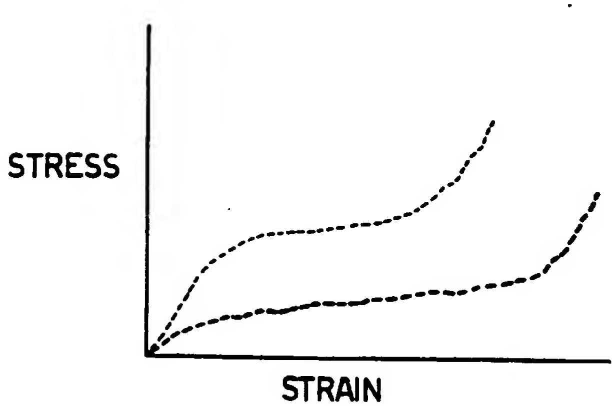


Fig.4.



INTERNATIONAL SEARCH REPORT

Interr nal Application No
PC↑/GB 95/03044

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B5/02 G03B21/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B G03B B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 627 638 (HUGHES AIRCRAFT CO) 7 December 1994	1,2,4-6, 8,9, 11-13, 15-18
	see column 3, line 18 - column 9, line 6 see figures 1-8	
Y		3,7,10, 14

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[X] Further documents are listed in the continuation of box C.

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28 March 1996	- 3. 04. 96

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INTERNATIONAL SEARCH REPORT

Inter   nal Application No
PC↑/GB 95/03044

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 294 122 (SCIENT APPLIED RESEARCH SAR) 7 December 1988 cited in the application see page 11, line 32 - line 36 see claims 1,3-6,8,9 ---	7,10,14
X	EP,A,0 464 499 (SUMITOMO CHEMICAL CO) 8 January 1992 see page 3 - page 5, column 21 see figures 1-4 ---	1,2,4,6, 8,12, 15-18
X	EP,A,0 381 417 (MATSUSHITA ELECTRIC IND CO LTD) 8 August 1990 see column 4, line 11 - column 6 see figures ---	1,2,4,6, 8,12, 15-18
A	PATENT ABSTRACTS OF JAPAN vol. 016 no. 209 (P-1354) ,18 May 1992 & JP,A,04 037735 (MITSUBISHI RAYON CO LTD) 7 February 1992, see abstract -----	7,14

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Information on patent family members

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PCT/GB 95/03044

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